

A Joint Publication of the Watershed Science & Wetland Science Institutes of the Natural Resources Conservation Service,
The University of North Carolina at Greensboro, and Pilot View Resource Conservation & Development, Inc.

The Restoration & Management of Small Wetlands of the Mountains & Piedmont in the Southeast:

A Manual Emphasizing Endangered & Threatened Species Habitat
with a Focus on Bog Turtles



The Restoration & Management of Small Wetlands of the Mountains & Piedmont in the Southeast:

A Manual Emphasizing Endangered & Threatened Species Habitat with a Focus on Bog Turtles

AUTHORS

Ann Berry Somers, *University of North Carolina at Greensboro*
Kenneth A. Bridle, *Heritage Lands Associates*
Dennis W. Herman, *North Carolina State Museum of Natural Sciences*
A. Barry Nelson, *Engineering Tectonics, Inc.*

COORDINATOR

Hank Henry
Watershed Science Institute, Natural Resources Conservation Service

CONTRIBUTORS

Nora Murdock, *US Fish and Wildlife Service*
Steven Lund, *Army Corps of Engineers*
Dick Everhart, *Natural Resources Conservation Service*
Matt Flint, *Natural Resources Conservation Service*
Ingrid Franzen, *Nicholas School of the Environment, Duke University*
Partick D. McMillan, *North Carolina State Museum of Natural Sciences*
Elizabeth Walton, *University of North Carolina at Greensboro*

PROJECT FACILITATOR

Pilot View Resource Conservation & Development, Inc.

November 2000

On the cover

Upper left: Bog turtle (Clemmys muhlenbergii) by Dennis Herman; bottom left: Meadow Bog by Dennis Herman; upper right: weir by Ken Bridle; lower right: Gray's Lily (Lilium grayi) and Canada Lily (Lilium canadense editorum) hybrid by Jennifer Mansfield-Jones.

For more information or copies visit: <http://rcdnet.org/PILOOTVIEWINC/>

Gray's Lily (Lilium grayi)



The significant problems we face cannot be solved at the same level of thinking we were at when we created them.

—Albert Einstein

The production of this technical publication was made possible by funding from the Watershed Science Institute, Wetland Science Institute, and the Wildlife Habitat Management Institute of the Natural Resources Conservation Service (NRCS). Hank Henry, Terrestrial Ecologist, NRCS Watershed Science Institute, NC, provided the inspiration, encouragement, and guidance for the manual.

The NRCS North Carolina State Office provided fund administration, and project coordination was through Pilot View Resource Conservation & Development, Inc.; Charles Anderson and Debbie Dodson of Pilot View facilitated the project with dedication.

Our sincere gratitude is extended to all of the landowners and caretakers who so graciously permitted access to their property during the studies which provided the foundation for this manual. Without their involvement, this publication would not have been possible.

Research support was provided by: Natural Resources Conservation Service, Wetland Science Institute; Project Bog Turtle, NC Herpetological Society; US Fish and Wildlife Service, Partners for Fish and Wildlife Program; Foothills Nature Science Society; NC Department of Transportation; NC Museum of Natural Sciences; NC Wildlife Resources Commission; The Duke Power Company Foundation; NC Wildlife Federation; and Reidsville Veterinary Hospital.

NRCS and outside reviewers made numerous insightful recommendations. Their insistence on accuracy and concise communication of the concepts that support the art and science of the restoration and management of these unique wetlands were most helpful. NRCS reviewers included: Carolyn Adams, Director, Watershed Science Institute, WA; Hank Henry, Terrestrial Ecologist, Watershed Science Institute, NRCS, NC; Louis Justice, State Biologist, NRCS, GA; Bruce Newton, Limnologist, National Water and Climate Center, NRCS, OR; and Ray Riley, Stream Mechanics Engineer, Watershed Science Institute, NRCS, NC. Outside reviewers included: Jeffrey C. Beane, Research Laboratory, NC Museum of Natural Sciences; Dr. Margaret Berry, retired Professor of English, John Carroll University, Cleveland, OH; Dr. James Howard, Dept. of Biology, Frostburg State University, Frostburg, MD; Dr. John Lepri, Dept. of Biology, UNC Greensboro, NC; Dr. Joseph Mitchell, Dept. of Biology, University of Richmond, VA; John Ann Shearer, Partners for Fish and Wildlife Coordinator, US Fish and Wildlife Service, NC; Bern Tryon, Curator of Herpetology, Knoxville Zoo, TN; Kevin Tweedy, NC Water Quality Group, NC State University; Hilary Vinson, Education Specialist, US Fish and Wildlife Service, NC.

Special thanks are extended to Moni Bates and Jeffrey C. Beane for reviewing scientific names and other technical information.

For site information and observations we thank Dr. James D. Pittillo, Western Carolina University, NC; Dick Everhart, Surry District, NRCS, NC; Dr. Kenneth M. Fahey, Brenau University, GA; Joseph H. Mickey, Jr., NC Wildlife Resources Commission; Bern W. Tryon, Knoxville Zoo, TN; Shawn Carter, VA Polytechnic Institute; Tom Davis, Blue Ridge Parkway, National Park Service, VA; Mike Pinder, VA Department of Game and Inland Fisheries; and Tom J. Thorp, Three Lakes Nature Center, Richmond, VA.

For assistance in data collection and support in other ways we thank the following: Hal Bain, Jeffrey C. Beane, Jean Berry, Charles Boles, Dr. Charles Bruton, Shawn Carter, Bill Crowell, Bob Davis, Tom Davis, Julie Elmore, Heather Gotwald, Megan Keefe Govus, Frank Gropen, Jim Green, Dr. Vince Henrich, Miranda Holcomb, Brannon Holcomb, Mary Kate and Bob Holden, Sherry Krest, Ron Linville, Merrill Lynch, Dr. Jennifer Mansfield-Jones, Scott Marsh, Dr. Laura Mazanti, Chris McGrath, Joseph H. Mickey, Jr., Bekky Monroe, David Pike, Mike Pinder, John Posey, Derrek Pulliam, Bill Reynolds, Jerry Reynolds, Nathan Rudd, David Sawyer, Tammy Sawyer, Lisa Schuyler, Trent Schuyler, John Sealy III, Christen Sible, Dr. Neal Stewart Jr., Rob Sutter, Ken Taylor, Tom J. Thorp, Bern W. Tryon, James L. Warner, and Joe Zawadowski.

Endangered species and scientific collecting permits were provided by the National Park Service (Blue Ridge Parkway), US Department of the Interior; NC Wildlife Resources Commission; and the VA Department of Game and Inland Fisheries. For technical assistance, we thank the following: Tim Barkley, Ruth Katzenstein, Jason Kinsey, and Dan Smith.

Design and layout were provided by Kim Davis.

Table of Contents

Preface	xi
Chapter One: Introduction	1
Manual Focus	3
What is a Wetland?	5
Benefits of Wetlands: Functions and Values	5
Can Wetlands Be Restored?	7
Importance of Landowners	8
Chapter Two: Ecology of Bog Turtles	11
Protected Status	14
Population Dynamics	14
Distribution	14
Habitat Dynamics	15
Threats to Bog Turtles and Their Habitat	16
Box 2.1 A Bog Turtle Metapopulation in North Carolina	17
Chapter Three: Identifying Important Small Wetlands and Potential Sites for Rare Species in the Southeast	23
Guidelines for Identifying a Potential Bog Turtle Wetland in the Southeast	26
What Should One Do if a Bog Turtle is Found?	28
Chapter Four: Planning for Success	31
Documenting Site Conditions	33
Site Hydrology	34
Wetland Size	35
Natural Communities	35
Wetland Animals	36
Wetland Plants	38
Landscape Ecology	38
Management Planning	40
Chapter 5: Managing Wetland Vegetation	45
Mechanical Woody Vegetation Removal Techniques	47
Box 5.1 Removal of Hardwood Canopy is Beneficial to the Bog Turtle	48
Box 5.2 A DOT Wetland Mitigation Site	50
Managing Woody Debris	51
Box 5.3 Woody Vegetation Cutting Suggestions	52
Grazing and Browsing Animals as a Means of Vegetation Control	52
Box 5.4 Mowing and Heavy Equipment Use Suggestions	53
Box 5.5 Wetland Grazing Suggestions	54
Chemical Controls of Vegetation	54

Application Techniques	55
Fire as a Management Tool	57
Box 5.6 Chemical Use Suggestions	57
Chapter 6: Managing Hydrology	63
The Hydrology of Meadow Bogs and Related Wetlands	65
Remediation Hydrology	67
Altering Flow	69
Changes in Water Levels	71
Dealing with Climate Change	71
Wetland Buffers to Control Polluted Runoff	72
Box 6.1 Hydrologic Management Suggestions for Meadow Bogs	72
Wetland Buffers as Life Zones for Wildlife	72
Box 6.2 Culvert Use by Bog Turtles	73
Managing Roadways	73
Restoring Hydrologic Regimes to Floodplain Wetlands	74
Wetland Management by Beavers	74
Chapter 7: Programs and Permitting	77
Federal and State Programs for Conservation of Wetlands	79
Non-governmental Organizations	81
Permits Required Under the Clean Water Act	83
Box 7.1 Agency Assisted Restoration and Research	84
Box 7.2 Alternative Livestock Watering Systems and Program Support	86
Reporting Wetlands Violations	87
Appendix A: Reference Wetland Plant Communities	89
Upland Depression Swamp Forest	91
Piedmont/Low Mountain Alluvial Forest	92
Piedmont/Mountain Bottomland Forest	92
Piedmont/Mountain Swamp Forest	93
Piedmont/Mountain Levee Forest	93
Low Elevation Seep	93
Swamp Forest-Bog Complex	94
Southern Appalachian Bog	94
Southern Appalachian Fen	95
High Elevation Seep	95
Upland Pool	96
Hillside Seepage Bog	96
Low Elevation Seep	97
Floodplain Pool	97
Meadow Bog (Wet Pasture)	98
Appendix B: Rare Animals and Plants of Southern Appalachian Wetlands	99
Table I Rare Animals of Southern Appalachian Wetlands	101
Table II Rare Plants of Southern Appalachian Wetlands	101
Appendix C: Example Handout on Endangered Species	109
Endangered Species and Piedmont North Carolina Landowners	111
Summary of the Federal Endangered Species Act	111
Summary of North Carolina Endangered Species Laws	113

Appendix D: Directory of Contacts for Rare Species	115
Directory of Contacts for Rare Animal Species (Including Bog Turtles)	117
Directory of Contacts for Rare Plant Species	119
Appendix E: Wetland Site Data Sheet	123
Appendix F: Informative Handouts for Landowners	131
So, I Have Bog Turtles	133
Meadow Bogs (Wet Pastures)	135
Project Bog Turtle	137
Appendix G: Additional Herbicide Information	139
Spray	139
Stem Injection	139
Stump Painting	139
Injection Lance	139
Wetland Labeled Herbicides	140
Summary	141
Glossary	145
Biographies of the Authors	151

List of Tables

Table 1.1 Methods of Altering Wetlands	4
Table 1.2 Importance of Wetlands	5
Table 4.1 Guidelines for Development of a Management Plan	39
Table 4.2 Ways to Reduce Risk of Failure in Wetland Restoration Projects	40

List of Figures

Figure 1.1 Generalized view of a western Piedmont landscape showing topographic and hydrologic units prior to alteration by draining and fragmentation by roads	7
Figure 2.1 Range of bog turtles (<i>Clemmys muhlenbergii</i>) in the Southeast	15
Figure 2.2 Bog turtle metapopulation showing subpopulations	17
Figure 4.1 Assessing restoration potential by using an hypothesized model for wetlands differing in degree of disturbance and landscape condition	34
Figure 6.1 Groundwater fluctuates with rainfall	66
Figure 6.2 Cross section through a Meadow Bog showing the position of the water table with respect to the width of the wetland and the ground surface	68
Figure 6.3 Timber gate system used to manipulate surface and groundwater levels at outlet point of the Meadow Bog	70
Figure 6.4 Illustration of a means for restoring periodic flooding of floodplain wetlands	75

Preface

In 1993, bog turtles (*Clemmys muhlenbergii*) were found in a wet meadow of the northwest Piedmont region of North Carolina during a Natural Heritage Inventory. Although the site appeared degraded and grazing pressure was heavy, there seemed to be enough remaining habitat to support a healthy population of this rare species, now protected by both state and federal law. Interest grew in the site and we began a population study which soon revealed that there were fewer turtles in the site than had been initially anticipated.

We began to talk about restoration. The US Fish and Wildlife Service saw potential for habitat improvement and provided funds through the Partners for Fish and Wildlife Program; the landowners provided the opportunity; and local conservationists provided the energy. However, hopes of success diminished as a review of the literature revealed very little on restoring, enhancing, or managing similar wetlands. But as the old adage suggests, “hope floats,” and before long, enthusiasm defeated pessimism. Instead of giving up, we expanded the scope of the project from a single-site project to one that focused on conducting basic research in techniques that could lead to the development of management guidelines for similar sites. As a number of state, federal, and private agencies were promoting restoration, the need for such information became progressively more apparent. The Wetland Science Institute of the Natural Resources Conservation Service responded to this need with additional funding.

Consequently, what started out as a small part of a local Natural Heritage Inventory became a project that inspired the development of this manual. Although the outcome of that particular project was especially

interesting, it need not be unusual. Conservation projects in general can have great power to pull together disparate special interests to achieve many common goals related to wetlands and the surrounding habitat, including game species management, stabilization of plant and animal populations in decline, flood control, and groundwater recharge. Restored wild areas benefit humans in many non-tangible ways also; many people not only enjoy observing wildlife, but are enriched by having intact pieces of the natural world in their surroundings.

There is no attempt here to make the readers of this handbook into soils, hydrology, wildlife, or legal experts. The assessment of soils, hydrology, biology, and topography generally require the technical assistance of natural resource conservation professionals. Alterations that change the hydrology of the land may require construction permits and evidence of design, engineering, and zoning compliance. These checks and balances are necessary to ensure that the landowner and community both benefit from correctly implemented projects, and that neither is burdened with the consequences of a failed project. Poor planning can lead to unsuccessful projects that sour the willingness of other landowners to restore wetlands. It is also important to note that until recently, and in the memory of most landowners, wetland management recommendations were usually “ditch, drain, and fill.” It may take time to convince landowners and their neighbors to give up current land uses in favor of restoration. Perhaps this manual will help.

Preservation and management of wetlands for the benefit of native wild plants and animals are the major foci of this manual, but the bog turtle is highlighted because

it is considered a flagship species. Flagship species are usually charismatic animals that have the ability to generate interest in a special habitat or a conservation project, and indeed the bog turtle does just that. Nevertheless, many other plant and animal species, rare and common, depend on wetland habitats found in the Mountains and Piedmont [here considered proper names] of the Southeast. The five states in the Southeast that currently have populations of bog turtles are Georgia, North Carolina, South Carolina, Tennessee, and Virginia. While the information in this handbook was specifically developed for these five states, it may also apply to similar types of wetlands found in other states.

Finally, our intent is to help increase awareness of the value of these sites, not only to their inhabitants, but also to the other native species living in the network of wetlands and other natural communities. Any small wetland can drastically affect life beyond its edges. Besides providing refuge to the many species not found in surrounding dry, terrestrial communities, they also improve the ecology for all the wild species in the region. Wetlands may benefit some terrestrial and avian species by providing additional nesting sites, drinking water, sources of nectar, vegetation for cover, or perhaps by increasing the numbers of prey species available for consumption. We hope to assist landowners and land managers in understanding the importance of each small wetland patch and the role each plays in preservation of species and their ecosystems.

Increased understanding of the values of wetland restoration will both motivate more restoration and educate the public about the vital need for this type of activity. In these days of global environmental decline and climate change, it is this type of restorative activity, to which each landowner can contribute, that will help to reverse some of the declines.

Ideally, the management strategies recommended here would be based on techniques that have been developed over years of sound scientific investigation in a variety of related fields. These fields would include hydrology, vegetational succession, population dynamics of native species, and biological and chemical limitations of alien plants. Although additional studies are underway, present knowledge of the dynamics of these systems is far from ideal. Management techniques recommended here are based on the best information available at the present time and the research and field experience of the authors. We make no pretenses that sufficient study has been conducted. To the contrary, this document is in part, a plea for more and better information that will allow small wetland management to proceed on a firm scientific foundation.

This document is only a beginning, and hopefully one that will grow and be modified as new information becomes available. We encourage you, the users of this manual (field personnel, farmers, researchers, landowners, conservationists, and critics), to respond with comments that might improve future editions.